Course Outline (winter 2018)
Earth 435: Advanced Structural Geology

Instructor:

Changcheng Li (ESC 209, ext. 33835, changcheng.li@uwaterloo.ca)
Office hour: Thursday 1-2pm

Lectures: Tuesday 8:30-9:50am (RCH 212), Thursday 8:30-9:50am (RCH 212)
Labs: Friday 2:30-5:20pm (EIT 1009)

Course Description:

This advanced structural geology course focuses on ductile deformation structures within rocks. It will introduce you how these structures are recorded and guide you to analyze how these structures develop and evolve in geological time. The evolution of these structures can be revealed by geometrical analysis and kinematic analysis. The analyses of structures, especially folds, will be introduced using real examples during lecture, and you will practice these analyses in lab assignments. One example will be given to show how tectonic evolution of an area can be revealed by the analyses of deformation structures within the area. Basics of continuum mechanics and its application to understand how deformation structures change orientations/styles in various flow fields are briefly introduced.

Learning objectives:

Be able to identify various ductile deformation structures from the mesoscopic to the microscopic scale. Understand how these deformation structures develop and know their associated tectonic environment. Be able to conduct geometrical analysis and kinematic analysis, and to use block diagrams to demonstrate the evolution of deformation structures base on analysis results. Understand basic continuum mechanics and how it can be applied to study the evolution of deformation structure in shear zones.

Resources:

Text Books (optional):

Passchier, C.W. and Trouw, R.A.J. 2005. Microtectonics, 2nd edition. Springer.
This book is available online through university library.

The following texts are on reserve in the DC library:

Turner, F. J. and Weiss, L. E., 1963. Structural analysis of metamorphic tectonites. McGraw-Hill. *QE601.T87*

Hobbs, B.E., Means, W.D. and Williams, P.F. 1976. An outline of Structural Geology. QE601.H6 1976

Ramsay, J.G. and Huber, M.I. 1983. Techniques of modern structural geology. V. 1, Strain analysis. QE601.R3

Most material comes from these texts above. Some material from other sources is also discussed during lectures.

Lecture Topics and schedule:

Week 1	January 4	Earth 435 introduction
Week 2	January 9, 11	Introduction to Advanced Structural Geology Some practical applications including an example of structural analysis and its tectonic implication
Week 3	January 16, 18	Foliations and Lineations: How to identify them in the field and recognize their overprinting Lab 2 introduction: Block diagram showing folds and faults
Week 4	January 23, 25	Folds and folding: Geometry, development and overprinting of folds Lab 3 introduction: Microscopic deformation structures
Week 5	January 30, February 1	Folds and folding: Geometry, development and overprinting of folds Lab 4 introduction: fold geometry analysis I
Week 6	February 6, 8	Review labs 1-4 and review for lecture midterm if necessary Lab 5 introduction: Geometrical analysis of folds II
Week 7	February 13, 15	Lecture midterm (February 13) Shear Zones and associated structures Lab 6 introduction: Geology in Eigerwald
READING WEEK		
Week 8	February 27, March 1	Shear Zones and associated structures Lab 7 introduction: Microstructures in ductile shear zones
Week 9	March 6, 8	No class on March 6 to allow you to go to PDAC. Flow of rocks and continuum mechanics
Week 10	March 13, 15	Flow of rocks and continuum mechanics Lab 8 introduction: Calculating strain in shear zones
Week 11	March 20, 22	Flow of rocks and continuum mechanics Time for you to work on term project
Week 12	March 27, 29	Project presentation
	April 3	Project presentation

Lecture topics and their schedule are subject to change.

Lab topics and schedule:

Week 1	January 5	No lab
Week 2	January 12	Lab 1 introduction Lab 1: Representation of attitudes of planes/lines and equal-area projection
Week 3	January 19	Lab 2: Understand geological maps and construct a block diagram showing folds and faults
Week 4	January 26	Lab 3: Microscopic deformation structures
Week 5	February 2	Lab 4: fold geometry analysis I: Analysis of 2 generations of folds using a stereonet

Week 6	February 9	Meeting for term project (topics assigned); Lab 5 Geometrical analysis II: folds
Week 7	February 16	Lab 6 Geology in Eigerwald
READING WEEK (Feb.19-23)		
Week 8	March 2	Lab 7 Microstructures in ductile shear zones
Week 9	March 9	Lab 8 Calculating strain in shear zones
Week 10	March 16	Lab review
Week 11	March 23	Lab Test
Week 12	April 4	Lecture Final

Lab schedule is subject to change.

Marking Scheme:

8 lab assignments:	16%
Quizzes	5%
Lecture midterm	15%
Oral presentation	12%
Written report	12%
Lecture final	25%
Lab test	15%
	100%

Lab assignments are either handed out to students in hard copies or posted on LEARN. Tracing paper, a ruler, a protractor, and a Schmidt net (equal-area net) are needed for lab assignments. The Schmidt net can be downloaded from LEARN, and be printed out on a piece of letter-sized paper. Make sure you do not resize it when you print it out.

Students normally have one week to complete each lab assignment. Each lab assignment should be handed in at the next lab class. Late assignments are penalized 10% per day and a mark of zero is given if the assignment is not submitted before assignments are returned. Assignments are normally returned two weeks after they are handed out.

Students can work individually or in groups of two on a project. Each group will be given a topic or can choose one approved by the instructor. The students are expected to research the topic, to present some ideas, and to write them up into a report in a format comparable to that used in current scientific journals. The main body (without the abstract, figures, tables or references) of the project report should be double-spaced text

around 10 pages. Be sure to include a critique of the papers on the topic, and present your own ideas about the topic.
The length of oral presentation will be ~15 minutes for a group of two and ~10 minutes for students who work on the project by herself/himself.

Examination regulations as outlined in the current UW undergraduate calendar are to be followed.

ACADEMIC INTEGRITY (from the Science Undergraduate Office):
In this course, any of the following is considered unacceptable

1. Having or sharing hard copies or digital copies of laboratories completed in previous years
2. Having or sharing hard copies or digital copies of quizzes or the lecture midterm from previous years
3. Re-creating test questions and answers without the express permission of the course instructor
4. Obtaining, distributing or receiving unauthorized academic material (old quizzes, exams and projects) without the express consent of the course instructor
5. Sharing unauthorized course-related materials (old quizzes, exams and projects) via hard-copy, email, social media or LEARN
6. Using LEARN email lists to sell or distribute unauthorized academic material

Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy #70, Student Petitions and Grievances, Section 4. When in doubt please be certain to contact the department's administrative assistant who will provide further assistance.

Discipline: A student is expected to know what constitutes academic integrity, to avoid committing academic offenses, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offense, or who needs help in learning how to avoid offenses (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course professor, academic advisor, or the Undergraduate Associate Dean. For information on categories of offenses and types of penalties, students should refer to Policy #71, Student Discipline, https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71. For typical penalties check Guidelines for the Assessment of Penalties (http://uwaterloo.ca/secretariat/policies-procedures-guidelines/guidelines/guidelines-assessment-penalties).

Appeals: A decision or penalty imposed under Policy #70 (Student Petitions and Grievances) (other than petitions) or Policy #71 (Student Discipline) may appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy #72 (Student Appeals, https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-72).

Graded materials: unclaimed assignments will be kept for one year after the end of course.

For students with disabilities: The Office for Persons with Disabilities (OPD), located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the OPD at the beginning of each academic term.